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To: . Mr. J. E. Wickham ✓ Date: October 21, 1988

From: . Barbara S. Mait

Subject: . Cigarette Firmness Testing

A collaborative cigarette firmness study was agreed upon by PME and PM R&D. This study was set up in Neuchatel Septemer 6-8, 1988. This study was designed to meet the following objectives:

1. Determine whether differences in methodology affect firmness results generated by R&D and PME.

2. Determine whether environmental conditions affect firmness results generated by PME and R&D.

3. Compare the cigarette firmness of brands manufactured by PM Europe and European competitors.

4. Recommend a procedure for the calibration and the standardization of the firmness instrument.

It should be noted that PME has not received any customer complaints on firmness.

TESTING PROTOCOL

The brands chosen for this study represent both Philip Morris Europe brands, European competitive brands and two US Marlboros. A list of the brands is available upon request.

The following testing protocol was agreed upon by PME and R&D.

1. The laboratory would perform the "as is" firmness test under the established methodology used in each respective lab. This test was to include different operators and different instruments. (This is Test 1)

2. Each laboratory would then perform the "as is" firmness test with the following changes. These changes were implemented to eliminate methodological and operator variables. (This is Test 2)

   a. Oven volatiles would be performed on the same amount of tobacco for the same amount of time.

   b. The red holder would be used for all cigarettes, regardless of circumference.

   c. FTC conditions (75°F and 60% RH) would be used.

   d. Only one operator and one instrument would be used for this test.

Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001

A summary of the results from Test 1 and Test 2 are shown in Tables I and II. The testing was performed in both laboratories from September 19 through 23. The results from Test 1 show a 0.5 mm systematic difference between the two labs; Test 2 results show a 0.3 mm systematic difference. The entire results of this test are available from Cigarette Testing.

A followup visit was made to FTR October 2-5. During this visit, it was discovered that the instrumentation used during the study was different and that the FTR laboratory was not operating under ISO conditions. In addition, the R&D instrument taken to FTR for comparative testing began to malfunction. Explanations for instrumentation differences are summarized by C. Higgins in a separate report.

INSTRUMENTATION

Two different model firmness instruments (an old model (1981) and a new model (1985)) are in use throughout PME and PM USA. Locations and the instruments used in these locations are listed below:

	PM USA			PM EUROPE	
	Old	New		Old	New
R&D		3	FTR	2	
Semiworks		3	FTR (R&D)		1
Standards Lab		1	PM Belgium	1	
QA	1	3	PM Munich	1	1
TQAF	1		PM Berlin	1	1
Louisville	2	1	PM UK		1
Cabarrus	1	1	PM Holland	2	
Manufacturing Center	1				
Stockton Street		1			

METHODOLOGY

Although the firmness procedure used in R&D was adopted from the PME procedure, some methodology differences exist. These differences are listed below:

	PME	R&D
1.	ISO Conditions	FTC Conditions
2.	Oven volatiles performed on 10 cigarettes for 100 minutes at 103°C	Oven volatiles performed on 10 grams of tobacco for 3 hours at 100°C

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3.	Uses red holder regardless of circumference of cigarette (exception - Marlboro 100 - uses dark green holder)	Measures circumference of cigarette (with Laser Mike®) to determine holder size for testing
4.	Does not determine tobacco weight.	Determines tobacco weight.

The collaborative study results are so inconclusive that it is impossible to determine if these methodology differences affect firmness. However, to determine if temperature influences firmness, tests are being conducted in R&D on brands in the firmness range of 2.5 to 3.4 mm at both FTC and ISO conditions. When these tests are complete, perhaps the difference in firmness values can be explained by temperature differences in the two laboratories. This testing is being conducted by J. Stargardt and will be reported under separate cover.

CIGARETTE FIRMNESS REPORTING

Cigarette firmness is reported in several reports by PM R&D, PM QA and PME. The manner in which firmness is reported by the three different laboratories is discussed below:

PM R&D

Research and Development reports firmness on an "as is" basis. That is, the firmness is determined of on cigarettes straight out of the pack. Upon special request, firmness is performed on cigarettes equilibrated for 48 hours. This is known as "equilibrated" firmness. Oven volatiles are performed in conjunction with firmness values. Data reported from R&D are not corrected or adjusted for oven volatiles. Firmness values for the collaborative study are "as is" firmness.

PM QA

Quality Assurance performs only "as is" firmness. However, QA reports both an "as is" firmness and an adjusted firmness value. The "adjusted" firmness value is calculated using the equation found in Table III. This equation corrects for oven volatiles, circumference and tobacco weight. For informational purposes, the target firmness values for some selected Philip Morris brands are given in Table IV.

PME

The Manufacturing Services Group in Neuchatel receives firmness values each month from the various European factories. The firmness values, along with other smoke and physical parameters, are compiled by this group and reported in the Product Monitoring Report. It should be noted that the Manufacturing Services Group receives from the various factories the monthly average calculated firmness and oven volatile values. Thus, the firmness values reported in the Product Monitoring Report are not generated in Neuchatel. The "as is" firmness value in the report is obtained by using a correction factor of .4/% OV. This "as is" value is calculated by the Manufacturing Services Group. Confusion arose over correction factors and reporting of firmness values to one or two decimal places. This confusion should be alleviated as FTR has agreed to be consistent in reporting firmness values.

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Mr. J. E. Wickham 10/21/88

OPERATOR AND INSTRUMENTATION VARIABILITY

The collaborative study was designed to determine if two different instruments and/or different operators would affect firmness values. Results from the tests in R&D where two instruments and several operators were used showed no difference from the test where one operator and one instrument was used. During the return visit to FTR, it was discovered that FTR used only one operator and only one instrument for both Tests.

An operator/instrument test was designed while in FTR. The test results showed that different operators and different instrumentation did not affect firmness values. These data are given in Table V.

LABORATORY CONDITIONS

During the study the laboratories were instructed to record temperature and humidity values. The R&D laboratory consistently read within the FTC standard of 75°F± 1° and 60% ± 1 RH. FTR, however, had an average humidity reading of 44% while performing the ISO condition test. This level is approximately 20% below the designated ISO humidity of 60%. The effect of humidity differences is unknown at this time.

CONCLUSIONS

No real conclusions could be reached on the original test objective during the follow up visit to FTR. However, the data generated indicated that Philip Morris brands tend to be comparable in firmness to the competition.

Two issues which were raised during the follow up visit were resolved. FTR has stated that Europe will use only the new firmness instrument and that the Product Monitoring Report will be consistent in reporting firmness to the same number of decimal places.

RECOMMENDATIONS

Based on the information available the following recommendations can be made:

1. Laboratory (temperature and humidity) conditions need to be improved in PME.

2. Uniformity in instrumentation should be achieved throughout Europe and the US.

3. A calibration/certification should be performed on all the instruments used for testing.

4. A standard needs to be developed to insure all instruments are reading correctly.

5. A uniform manner of reporting firmness values needs to be established.

Until these issues have been resolved, it would not be advisable to perform any collaborative studies.

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TABLE I
TEST 1
CIGARETTE FIRMNESS DATA

Mfg	Brand	Firmness, mm		O.V., %		Calc. Firmness at 12.5%	
		R&D	PME	R&D	PME	R&D	PME
PM	Muratti Ambassador (France)	3.1	2.7	11.6	11.8	3.3	3.0*
	Chesterfield (Italy)	3.4	2.8	12.4	12.2	3.4	2.9
	Marlboro Lights Box (France)	3.3	2.7	12.5	12.3	3.3	2.7
	Marlboro 85 (France)	3.4	2.9	12.5	12.5	3.4	2.9
	Marlboro 85 (Switzerland)	3.4	2.9	12.9	12.7	3.2	2.8
	Marlboro 85 (Germany)	3.4	2.8	12.9	12.1	3.2	3.0
	PM Super Lights (Holland)	3.4	2.8	12.5	12.6	3.4	2.8
	Marlboro 85 (U.S.)	3.0	2.4	12.9	12.9	2.8	2.3
	Marlboro 80 (U.S.)	3.1	2.6	13.3	12.8	2.8	2.5
R.J.R.	Camel (Switz)	3.1	2.6	13.0	12.8	2.9	2.5
	Camel (France)	3.3	2.7	13.0	12.6	3.1	2.6
	Camel (W. Germany)	3.5	2.9	12.8	12.5	3.4	2.9
	Winston (Switz)	3.4	2.9	13.6	13.6	3.0	2.5
BAT	Barclay (Switz)	3.1	2.6	12.3	12.3	3.2	2.7
	Lucky Strike (Switz)	3.0	2.6	12.6	12.2	3.0	2.8
Monital	MS (Italy)	3.0	2.6	12.8	12.7	2.9	2.5
Turmac Int.	Peter Stuyvesant (France)	3.4	2.7	12.8	12.6	3.3	2.7
Reemtsma	West (W. Germany)	3.2	2.7	13.5	13.0	2.8	2.4

*Muratti Ambassador is corrected to 12.0%. All other brands are corrected to 12.5%.

	Actual	Target		Actual	Target
PME	Temp 21.4° - 23.2°	(22°)	R&D	Temp 75.0 - 75.3°F	(75°C)
	RH 39.92 - 47.95	(60%)		RH 60.4 - 61.2%	(60%)

Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001

TABLE II
TEST 2
CIGARETTE FIRMNESS DATA

Mfg	Brand	Firmness, mm		O.V., %		Calc Firmness 12.5% O.V	
		R&D	PME	R&D	PME	R&D	PME
PM	Muratti Ambassador (France)	3.1	2.9	11.6	11.7	3.2	3.2*
	Chesterfield (Italy)	3.4	3.1	12.4	12.4	3.3	3.1
	Marlboro Lights Box (France)	3.4	3.0	12.5	12.6	3.4	2.9
	Marlboro 85 (France)	3.3	3.1	12.5	12.7	3.3	3.1
	Marlboro 85 (Switz)	3.4	3.0	13.1	12.8	3.2	2.9
	Marlboro 85 (W. Germany)	3.5	3.1	13.1	12.4	3.3	3.1
	PM Super Lights (Holland)	3.3	3.1	12.5	12.3	3.3	3.1
	Marlboro 80 Box (US)	3.1	2.9	13.5	13.1	2.7	2.6
	Marlboro 85	3.0	2.6	13.1	12.6	2.8	2.6
RJR	Camel (Switzerland)	3.1	2.9	13.1	12.6	2.9	2.8
	Camel (France)	3.2	2.9	12.9	12.7	3.1	2.9
	Camel (W. Germany)	3.5	3.2	12.7	12.4	3.4	3.2
	Winston (Switz)	3.5	3.2	13.9	13.7	3.0	2.7
BAT	Barclay (Switz)	3.1	2.9	12.5	12.5	3.1	2.9
	Lucky Strike (Switz)	3.0	2.8	12.7	12.2	3.0	3.0
Monital	MS (Italy)	3.0	2.8	12.9	12.7	2.8	2.7
Turmac Int.	Peter Stuyvesant (France)	3.3	3.0	13.0	12.6	3.2	3.0
Reemtsma	West (W. Germany)	3.1	2.9	13.3	13.1	2.8	2.8

*Muratti Ambassador is corrected to 12.0%. All other brands are corrected to 12.5%

Target Temp 75° ± 1° PME Temp 75.2 to 75.6° R&D Temp 75.2 to 75.4°
RH 60% ± 1 RH 59 to 61% RH 60 to 61%

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Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001

TABLE III

ACTUAL FIRMNESS - (O.V. - TARGET O.V.) .38 +

(WEIGHT - TARGET WT.) .009 -

(CIRCUMFERENCE - TARGET CIR) .56 =

ADJUSTED* FIRMNESS

*ADJUSTED = TARGET FIRMNESS

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Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001

TABLE IV

	Adjusted (Target) Firmness, mm
Alpine	2.8
B&H Lights	2.8
B&H DeLuxe Ultra	2.9
B&H 100	2.8
Cambridge	2.8
Marlboro 80, 85 & 100	2.8
Marlboro Lights 85	2.9
Marlboro Lights 100	2.8
Merit 85 & 100	2.8
Merit Ultra 80, 85 & 100	2.9
Parliament 80 & 85	2.9
Parliament 100	3.0
Players Lights 85 & 100	2.8
Players 85 & 100 Box	2.9
Saratoga	2.8
Virginia Slims	2.8
Virginia Slims Lts.	2.8
Virginia Slims Ultra Lts.	2.9

Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001

TABLE V

OPERATOR TEST

INST/HOLDER	P. SOGUEL	A. HEYRAND	C. HIGGINS	B. MAIT
PME/PME	3.16/0.08	3.12/0.08	3.25/0.07	3.16/0.07
PME/PMUSA	3.26/0.09	3.17/0.08	3.25/0.08	3.22/0.08
PMUSA/PME	3.21/0.11	3.18/0.08	3.19/0.13	3.10/0.07
PMUSA/PMUSA	3.23/0.09	3.22/0.19	3.19/0.22	3.13/0.09

n=8

Date 10/5/88

Source: https://www.industrydocuments.ucsf.edu/docs/rfpk0001